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**Training Situation Awareness and Adaptive
Decision-Making Skills Using a Desktop Computer
Simulation**

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**U.S. Army Research Institute
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14. ABSTRACT (<i>Maximum 200 words</i>): This report describes research designed to: 1) determine the feasibility of a low-fidelity desktop computer simulation called Simulation Field Exercise (SimFX) to train small unit leader situation awareness (SA) and adaptive decision-making skills; and 2) assess the effectiveness of a training protocol consisting of advance organizers (information to familiarize individuals in the areas of SA and the application of key leader processes to facilitate decision-making) and formative, process oriented feedback. Thirty-five Infantry junior officers were randomly assigned to either an experimental or control condition. The Soldiers, role playing a dismounted Infantry Platoon Leader, conducted three mission scenarios reflecting current operations. Adaptive decision-making capability and SA were assessed for each mission. The experimental group obtained significantly higher adaptive decision-making scores than those in the control group. SA and adaptive decision-making scores were significantly correlated for scenarios 1 and 2 such that higher adaptive responding was associated with higher SA ratings. The experimental group used significantly more assets (a measure of SA) than the control group. Strategies for enhancing the training effectiveness of low-fidelity desktop computer simulations such as SimFX are described. SimFX refinements are identified for application to large classes with high student throughput.					
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TRAINING SITUATION AWARENESS AND ADAPTIVE DECISION-MAKING SKILLS USING A DESKTOP COMPUTER SIMULATION

EXECUTIVE SUMMARY

Research Requirements:

Small unit leaders (platoon, squad, team) must be capable of taking effective independent actions across an increasingly diverse range of military missions. The small unit leader must be prepared to deal with a complex battlefield that could change in scope and lethality without warning. Critical to the unit's success is the leader's ability to recognize environmental cues and relevant situational factors, maintain situation awareness (SA), apply appropriate strategies, and make effective real-time decisions. Conducting the appropriate cognitive skills training at real-world training sites or through fully immersive virtual simulation systems can be resource intensive because utilizing these systems often involves multiple technical support personnel, trained role players, a coach, and access to a facility to house the simulation system. The monetary costs to conduct the training coupled with low Soldier throughput make the fully immersive virtual simulation infeasible for large courses such as the Infantry Basic Officer Leader Course. One solution is to conduct a portion of this training using relatively low-cost desktop computer simulations. The objectives of the current research were:

- Determine the feasibility of using a low-fidelity desktop computer simulation called Simulation Field Exercise (SimFX) to train small unit leader SA/adaptive decision-making skills.
- Assess the effectiveness of a training strategy consisting of: 1) advance organizers (preparatory materials) designed to familiarize the students in the areas of situation awareness and adaptive decision-making, and 2) formative feedback following each scenario-based decision point.

Procedure:

Thirty-five junior officers from the Infantry Basic Officer Leader Course (IBOLC) were randomly assigned to either an adaptive training (experimental) or control group. The experimental group received a training protocol consisting of advance organizers (information to familiarize individuals in the areas of SA and the application of key leader processes to facilitate adaptive decision-making) and formative, process oriented feedback (i.e., information explaining the implications of the decision and what the individual needs to do improve their adaptive decision-making skills). Both groups received summative feedback (percentage of correct decisions) following each mission scenario. The participants, role playing a dismounted Infantry Platoon Leader, individually conducted three contemporary operational environment (COE) mission scenarios. Scenarios included decision points that required the officer to take specific actions at each point. Decision-making capability and SA were assessed for each mission. In addition, participant responses to the training were obtained at the conclusion of the experiment.

Findings:

The experimental group obtained significantly higher adaptive decision scores than the control group. Adaptive decision scores (i.e., decision points that involved scanning the environment, using assets, interpreting the information correctly, and implementing the correct decision choice) changed significantly across scenarios. Participants' scores were highest for scenario 1 (Secure Key Terrain). The experimental and control groups did not differ significantly with regard to routine decision scores (e.g., selecting a movement formation, call for fire). Routine decision scores remained the same across scenarios. Although asset use (the primary way for gathering information and enhancing SA) significantly improved over time for both groups, the experimental group used significantly more assets than the control group. While the training manipulation significantly increased adaptive decision scores versus the control group, the processes mediating this improvement were not clearly demonstrated. The formative feedback designed to increase self-regulation processes in the experimental group was suggestive, based on item responses.

To identify and confirm the linkages between SA, assets used, and decision scores, a series of correlations were computed. Significant positive correlations were obtained between the number of assets used and adaptive decision scores for all three scenarios. Positive correlations also were obtained between the number of assets used and routine decisions, but the relationship was much weaker compared to the adaptive decision score-total asset correlations. The findings showed (with one exception) that higher levels of SA were related to higher number of assets used. Finally, SA and adaptive decision scores were significantly correlated for mission scenarios 1 and 2 (Urban Assault Mission) but not for scenario 3 (Assault and Secure Enemy Bridge) such that higher adaptive responding was associated with higher SA ratings. SA was significantly correlated with the number of assets used for scenario 1.

Overall, the research showed that SA/adaptive decision-making skills could be trained using a low-fidelity desktop computer simulation system employing the training format described. This was indicated by: 1) the higher adaptive decision scores of the experimental group versus the control group; 2) greater use of intelligence assets by the experimental group; 3) positive correlations between number of assets used and SA; and 4) positive correlations between SA and adaptive decision scores for two of the three scenarios.

Utilization and Dissemination of Findings:

Low-fidelity desktop computer simulations can be effective for conducting both applied and basic research in SA/decision-making. Conducting research in a controlled setting, such as this experiment, permits closer empirical scrutiny of the linkages between SA, self-regulation, and decision-making in dismounted infantry operations and highlights the utility of computer desktop simulations as low cost tools for training both SA and adaptive decision-making skills. To insure maximum benefit, this type of training should be combined with other learning strategies to include more formative, process-oriented feedback and small group discussions led by experienced trainers/facilitators. These approaches would enhance both understanding and transfer of the decision skills to operational/field environments.

TRAINING SITUATION AWARENESS AND ADAPTIVE DECISION-MAKING SKILLS USING A DESKTOP COMPUTER SIMULATION

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TRAINING SITUATION AWARENESS AND ADAPTIVE DECISION-MAKING SKILLS USING A DESKTOP COMPUTER SIMULATION

Introduction

Preparing small unit leaders (platoon, squad, and team) for the demands inherent in the contemporary operational environment (COE) presents many challenges to trainers. Leaders must be capable of taking effective independent actions across an increasingly diverse range of military missions including humanitarian assistance, peacekeeping, peace enforcement, and low intensity conflict as part of a joint, combined, or interagency operation (TRADOC PAM 525-66, 2001). The small unit leader must be prepared to deal with a complex battlefield that could change in scope and lethality without warning. The multifaceted nature of the COE demands that leaders possess an intellectual agility to quickly assess situations and make accurate decisions (U. S. Department of the Army, FM 6-22, 2006).

Classical versus Naturalistic Approaches to Decision-Making

The U.S. Army teaches both classical and naturalistic decision-making approaches in its formal schools at all leadership levels. These two decision-making styles are articulated in Army doctrine (FM 6-0, U. S. Department of the Army, 2003). Under the classical, rational choice approach, a range of options are generated, evaluation criteria are identified, criterion options are evaluated, results are calculated and the option with the highest score is selected. Classical approaches to decision-making focus on application and try to improve process regardless of content area. The classical approach underlies the Military Decision Making Process (MDMP), the Army's doctrinal method of mission planning, and can be effective when used in situations with low time pressures and stable problems.

Context-free, rational choice strategies do not, however, provide an optimal means for improving decision-making skills in naturalistic environments (Means, Salas, Crandall & Jacobs, as cited in Klein, 1997). Klein (1997) argued that this approach may be ineffective in today's fast-paced COE because it tries to accommodate all situations but does not fit any specific situation very well. Moreover, the constraints of naturalistic settings may make it impossible to apply the classical, rational choice approach. Klein's work (as cited in Drillings and Serfaty, 1997) revealed that individuals do not appear to use the classical approach to decision making in difficult situations and under time pressure, even when they were trained in that approach.

Instead, individuals use what Klein (1997) described as a naturalistic approach to decision-making, which differs significantly from classical, context-free, rational choice strategies. Naturalistic settings are characterized by uncertain dynamic environments, shifting or competing objectives, time constraints, and high stakes (Klein, 1997). Klein hypothesized that decision-making in real world environments involves understanding the situation and judging its familiarity to other situations. Thus, the application of the naturalistic approach offers military leaders a more effective strategy for making quick, accurate decisions under high duress and uncertainty. As such, greater training value can be obtained by helping individuals to quickly assess the situations confronting them by improving their proficiency in recognizing cues and patterns.

The Role of Situation Awareness (SA) in Naturalistic Decision-Making

Situation awareness refers to the cognitive processes leading to sound, timely decisions regarding likely future events in a particular environment (Endsley, 1997). Specifically, situation awareness involves: 1) perceiving the elements in a particular environment; 2) understanding the meaning of those elements and; 3) translating the perception and understanding of the environment into a projection of future events likely to occur in that environment. Under realistic conditions, experts make decisions utilizing a holistic process involving the recognition of situations and matching of patterns against mental schemas to make rapid decisions (Drefus; Klein; Klein, Calderwood, & Clinton-Cirocco as cited in Endsley, 1997). Within this model, a person's situation awareness, an internal conceptualization of the present situation, becomes the driving factor in the decision-making process (Endsley, 1997).

According to Endsley (1997), many human errors that are attributed to poor decision-making usually involve problems with the SA portion of the decision-making process. People make decisions based on their perceptions of the situation, but often those perceptions are in error. In realistic settings, the major task facing the decision-maker is establishing an ongoing awareness and understanding of the key situational components. Situation awareness provides the primary input to the decision process and plays a significant role in determining which course of action is selected.

To be successful in the COE, the small unit leader must become proficient in making rapid, accurate assessments of the situation, and he must be able to make decisions under varying levels of uncertainty and severe time constraints. This will place a premium on the leader's ability to simultaneously read and assess the significance of various situational and tactical cues and to efficiently manage the timing of decisions/mission events (Cannon-Bowers & Bell, 1997; Klein, 1997). Klein's work suggests that the leader's ability to recognize environmental cues and relevant situational factors, maintain situation awareness, apply appropriate strategies, and make effective real-time decisions are key determinants impacting unit success. This intuitive, rapid, recognition primed decision making process is central for the individual to be able to adapt to new situations. For the present research, adaptability refers, in part, to rapid decision-making (see Roper & Vandergriff, 2003, for a thorough discussion of naturalistic decision-making and its linkage to leader adaptability).

Factors moderating situation awareness among individuals. Significant individual differences exist in the degree to which people are able to detect and assimilate information to form a coherent and complete picture of the situation. A number of factors may contribute to individual differences in SA ability such as pattern matching skills, perceptual speed, spatial ability, and attention sharing (Strater, Endsley, Pleban, & Matthews, 2001). Some of these skills/abilities may be more amenable to training interventions than others. One such skill is environmental scanning which includes tracking environmental changes and diagnosing how changes in these conditions will influence the accomplishment of the mission.

Training SA and Adaptive Decision-Making Skills

Developing the appropriate skills, e.g., scanning, would require exposing the small unit leader to multiple scenarios and providing sufficient practice and timely feedback so he can effectively assimilate the many lessons learned from the training (Pleban, Eakin, Salter, & Matthews, 2001). The role of practice and feedback in developing expert performance has been well documented (Ericsson, Krampe, & Tesch-Roemer, 1993), and has been extended to adaptive thinking behaviors of military leaders (Shadrick & Lussier, 2004) and to naturalistic, intuitive decision-making processes (Klein, 2003).

However, some of the training approaches for developing SA and adaptive decision-making skills can be quite costly. For example, Pleban, et al. (2001) employed a fully immersive virtual simulation system to train small unit leader SA and decision-making skills. While effective, the use of such a training system was not cost effective. The training for one Soldier required an entire day for the simulation, multiple technical support personnel, trained role players, a coach, and access to the facility that housed the simulation system. The monetary costs involved to conduct the training coupled with low Soldier throughput make the fully immersive virtual simulation infeasible for large courses, e.g., Infantry Basic Officer Leader Course, Basic Noncommissioned Officer Course.

As a result, there has been an increased focus on developing low-fidelity desktop computer simulations that allow larger groups of Soldiers to be trained at multiple sites for less cost compared to the system described above (see Archer, Brockett, McDermott, Warwick, & Christ, 2006). Central to the development of all simulation-based training is how much realism is needed in the simulation to ensure an engaging training experience in which the appropriate skills are developed. The fully immersive virtual simulations that were used by Pleban, et al. (2001) may not be necessary to develop small unit leaders' cognitive skills reflecting SA and the ability to make quick, accurate decisions.

An alternative to the immersive approach is outcome-driven simulation (Gordon, 2004). In outcome-driven simulation, the goal is to exploit the cognitive realism that can be developed from engaging the student in a story or vignette. The student must make a series of decisions that moves the story forward to new situations that are relevant to the training objectives. Thus, the user's decisions affects how the scenario plays out. Outcome-driven simulation replaces the continuous environment of the fully immersive virtual simulation with a branching storyline and a series of key decision points, where the training developer maintains control over the interactions between the students and the simulation (Archer, et al., 2006). The key to the successful employment of the outcome simulation training approach is the ability of the training developer and subject matter expert to construct realistic scenarios that challenge the students and address selected teaching objectives.

Simulated Field Exercise (SimFX) Tool. SimFX was used in the present research to investigate the effects of a new training protocol for improving both SA and small unit leader adaptive decision-making skills. It was developed as a low cost alternative (low-fidelity desktop computer simulation) to the fully immersive virtual simulation systems described earlier (Archer, et al., 2006). SimFX consists of two software components: a player component that presents a training scenario to a student and an author component that allows the trainer to build the training scenario to address specific training objectives. Two types of training exercises can be developed using SimFX. The first exercise is based on the branching storyline approach. In this type of exercise, the student is first given a description of the mission which can vary in length and complexity. When the student is ready to begin the mission, he is confronted with the first decision via a decision dialog window. The dialog window provides a description of the current situation and a set of alternative courses of action. Based on the student's inputs, SimFX displays the next decision dialog window. The dialog window first presents feedback on the student's previous decision and a narrative segment describing the consequences of that decision in the context of the unfolding mission. The decision dialog window then moves to the next decision point by describing a new situation and a new set of decision alternatives. The process continues until the mission ends in success or failure, e.g., the mission times out, or, due to poor leader decisions, the unit suffers extensive casualties and is no longer combat effective. See Figure 1 for an example of the window displays used in SimFX.

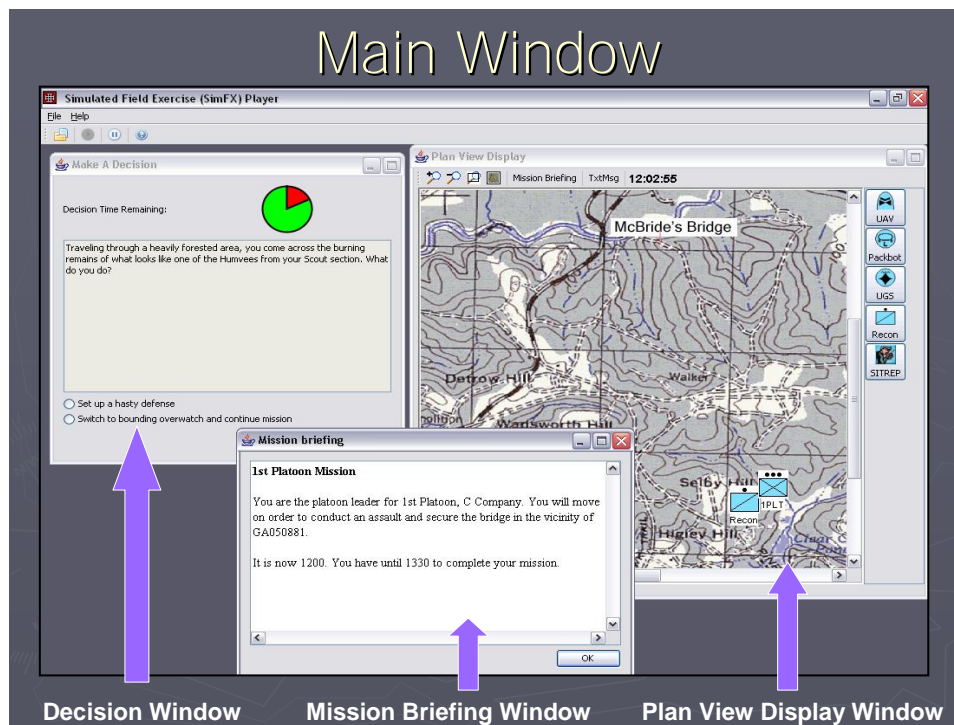


Figure 1. Example window displays used in SimFX.

The second type of training exercise provided by SimFX is deliberate practice. Deliberate practice exercises do not follow a branching storyline. Instead, students receive multiple trials with the same decisions but with different information accompanying each decision. Deliberate practice exercises provide opportunities for students to look at a problem from different perspectives and develop different courses of action.

The author component of the SimFX tool is used by the trainer (author) to create a story-based experience for the students consisting of a branching storyline composed of linked decision nodes. For each decision node, the trainer must program a series of decisions and provide sufficient context to orient the students in the story, make available information assets (e.g., maps, aerial/ground photographs, text messages from sensors/radio communications) to assist the students in making the decision, and provide narrative feedback to address the students' choices and describe the consequences of their decisions (see Archer et al., 2006 for a complete description of the SimFX tool and its components).

Research Objectives

One objective of this research was to investigate the feasibility of a low-fidelity desktop computer simulation (SimFX), employing a scenario-based instructional approach, to train small unit leader SA/adaptive decision-making skills. A second objective was to assess the effectiveness of a training strategy that included: 1) preparatory materials (advance organizers) designed to familiarize the students with applying situation awareness and adaptive decision-making skills (e.g., Kraiger, Salas & Cannon-Bowers cited in Burke & Hutchins, 2007), and 2) formative feedback following each scenario-based decision point (e.g., Bransford, Brown, & Cocking, 2000). These techniques have been shown to increase both learning and transfer.

Method

Participants

Participants were 35 male second lieutenants attending the Infantry Basic Officer Leader Course (IBOLC) at Fort Benning, Georgia. Complete demographics are presented in Table 1.

Table 1
Participant Demographics

Age (in years)	Years in Military	Commissioning Source <i>n</i> (%)	Prior Enlisted <i>n</i> (%)	Deployed to OIF/OEF <i>n</i> (%)
M = 24.7	M = 3.4	ROTC 18 (51)	11 (31.4)	8 (23.0)
SD = 4.2	SD = 4.8	USMA 6 (17)		
		OCS 10 (29)		

Note. *n* = 34. One participant did not provide demographic information.

Measures

Three SimFX mission scenarios were developed for the experiment that required the participants to: 1) secure key terrain to facilitate the battalion's main attack; 2) conduct an urban assault (as quick reaction force), and 3) assault and secure a bridge to facilitate passage of friendly forces. The scenarios were developed by an Infantry Officer (a Captain) with recent command experience in Operation Iraqi Freedom (OIF) to ensure they were representative of missions currently performed in the COE.

Participants completed three paper-and-pencil instruments during different phases of the experiment. After each trial (scenario), the participants completed the Mission Awareness Rating Scale and the Post Trial Participant Subjective Questionnaire. At the conclusion of the experiment, participants completed the Post Experiment Questionnaire. These instruments are described briefly in the following sections.

Adaptive and routine decisions. Each scenario consisted of between seven to 16 decision points. Participants were presented with four answer choices for each adaptive and routine decision point within each scenario and received one point for selecting the worst answer choice and four points for selecting the best answer choice. Decisions in the scenarios that were novel, complex, and required a shift in perspective (frame switch) were coded as adaptive decisions. Specifically, an adaptive decision was defined as one in which the participants engaged in the entire adaptive process described in the training protocol, i.e., scanned the environment using available assets, interpreted the information correctly, and then implemented the correct response choice. Participants received an additional point for engaging in all steps comprising the adaptive process.

An example of a decision point in scenario 2 is provided below (See Appendix A for brief descriptions of each mission scenario and example decision points. Also included are listings of each decision point, choice responses, and item point scores by scenario.)

...as the Brigade advances, threat forces incite a large civilian mob to march on Brigade units. Some forces attack using women and children as human shields. Their goal is to produce fratricide and ideally trap non-combatants in a cross-fire, influencing public opinion through news footage of civilians killed or injured by heavily armed forces. The 1st Platoon of C Company is the lead element that will confront the civilian mob. The Company Commander asks you for your recommendation for disbursing the mob. You consider the following options:

- (a) Use non-lethal munitions*
- (b) Use tear gas*
- (c) Use mortars to engage the rear of the mob where enemy Soldiers are suspected to be located*

Example feedback for option ‘C’ leading to a short answer question:

This is not a good option since there is a high risk of killing and/or wounding civilians. There is no assurance that the enemy Soldiers are located at the rear of the mob (they may be interspersed).

Why did you choose to use mortars to engage the rear of the mob where enemy Soldiers are suspected to be located? In the box below, please briefly describe why you made that decision. The participant is then presented with a text box in which to write a short answer.

For this decision point, if the participants accessed the appropriate assets (UAV and weather report) and opted to use non-lethal munitions as opposed to tear gas, then they would be credited with making the appropriate adaptive response for the situation. There are several reasons why it was important for the participants to utilize these assets and use non-lethal munitions: 1) the UAV provided valuable information concerning the location of the mob in relation to friendly forces; 2) the weather report provided information on the direction of winds which would determine which crowd dispersal system to use; and 3) use of non-lethal munitions allowed for the larger stand off between Soldiers and the mob. Thus, the participants who selected the correct assets and used non-lethal munitions were awarded the assigned points for this decision plus one bonus point.

Decisions that did not involve a high level of adaptability were classified as routine, e.g., selecting a movement formation, call for fire. The different types of decisions (adaptive and routine) were distributed randomly throughout the three scenarios (see Appendix A for a complete description of all adaptive and routine choice responses by scenario). Average scores were created for adaptive and routine decisions for each scenario; these scores were used in all subsequent analyses. Table 2 shows the means and standard deviations for each scenario.

Number of assets used. To make adaptive decisions, participants had to fully utilize the appropriate assets available to them in SimFX prior to picking a multiple choice option. The assets provided information about the ever changing SimFX environment, and most were “future

combat systems” such as *Small Unmanned Ground Vehicle and Packbot (SUGV)*, *Unmanned Aerial Vehicle (UAV)*, and *Unattended Ground Sensor (UGS)*; see Appendix B for a complete list of the assets and brief description of each). The number of assets available varied by scenario (three for scenario 1, five for scenario 2, and six for scenario 3). The average number of assets used by participants was obtained for each scenario. Table 2 shows the means and standard deviations for each scenario.

Mission Awareness Rating Scale (MARS). The MARS instrument was modified from the original eight-item instrument used in Matthews, Beal, and Pleban (2002) to a four-item measure that employed a Likert scale format (e.g., 1 = very easy to 4 = very difficult) to assess Endsley’s (1997) three levels of SA: identify, understand, and predict (see Appendix C for the items) plus how aware the participants were of how to best achieve their goals during the specific mission scenario. A total SA score was computed for each participant by averaging the three MARS items assessing Endsley’s three components of SA (items 1-3) for each scenario (Scenario 1 $\alpha = .64$, Scenario 2 $\alpha = .87$, Scenario 3 $\alpha = .81$). All items were recoded so that higher responses indicated better SA. Table 3 shows the means and standard deviations for SA for each scenario. The fourth item assessing goal achievement was analyzed separately (Scenario 1: $M = 3.10$, $SD = .61$; Scenario 2: $M = 2.40$, $SD = .88$; Scenario 3: $M = 2.57$, $SD = .70$).

Post Trial Participant Subjective Questionnaire. The Post Trial Participant Subjective Questionnaire consisted of three items presented in a Likert scale format to assess participants’ perceptions of how hard they were working during the mission (workload), how well they performed, and how aware they were to changing events during the mission. Tables 3 and 4 show the means and standard deviations for each scenario (see Appendix D for the items).

*Post Experiment Questionnaire.*¹ The Post Experiment Questionnaire included four items tapping self-regulation (e.g., *Before I made a decision, I thought of different ways of looking at the problem*; $\alpha = .63$, $M = 3.54$, $SD = .58$). Participants responded on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree); see Appendix E for the items).

Procedure

Experimental condition. Participants arrived at the ARI Warfighter Experimentation Lab in groups of 8-9 (for both the experimental and control groups). Participants in the experimental condition received the advance organizer protocol. They were first shown a 13-minute video entitled “Power Hungry” of a Company Commander receiving a mission to distribute food to the local population in a middle-east country (Hill, Gordon, & Kim, 2004). During the video, when the Company Commander does not successfully respond to a number of events, the mission fails. The experimenter reviewed these key events and emphasized the importance of paying attention to environmental cues by scanning and monitoring the environment so that the participants can

¹ Although participants’ cognitive workload also was assessed using the Post Experiment Questionnaire, preliminary analyses revealed that this measure was not associated with the measurements of cognitive workload following each scenario and that there were no significant differences between the experimental and control groups for this measure. The post questionnaire also included open-ended questions assessing the usefulness of the assets; however, these were not included in the analyses.

adjust the mission as required. The experimenter then provided a PowerPoint presentation that stressed the importance of certain behaviors related to mission analysis, environmental scanning, and strategy implementation that the participants needed to perform to be successful in the scenario-based missions they would encounter during the training.

Next, the participants were briefed on the SimFX desktop computer simulation system. They were given 45 minutes to familiarize themselves on the system and conduct a practice scenario. The participants then completed three mission scenarios using SimFX which required them to provide both multiple choice responses and short answers explaining the reasons for their choices. Each subsequent mission was different and involved realistic COE scenarios.

Formative feedback was provided after each decision point in each scenario to reinforce target behaviors (mission analysis, environmental scanning, and correctly analyzing mission requirements) or to encourage the participants to scan their environments for appropriate information/cues. An example of formative feedback used in this experiment is described below (see also the earlier example on page 7).

The platoon's mission is to secure a key piece of terrain. The Platoon Leader fails to use the two most critical assets, UAV and UGV for the decision point, actions. The formative feedback provided to the participant by the SimFX system included the following:

You are surprised when an enemy squad suddenly opens fire on your position from the rear, forcing you to take up a hasty defense. You are able to overpower them, but two of your men are wounded and MEDEVACed out. Remember to scan your environment for relevant information and utilize your assets before making a decision.

At the completion of each scenario, the participants received summative feedback (percentage of correct decisions made). Following the completion of each scenario, the participants completed the MARS and the Post Trial Participant Subjective Questionnaire. At the end of the experiment, the participants completed the Post Experiment Questionnaire.

Control condition. Participants in the control condition were treated identically to those in the experimental condition with two notable exceptions. First, they did not receive the advance organizer protocol consisting of the Power Hungry video accompanied by the experimenter's comments addressing the importance of scanning the environment for cues or the PowerPoint presentation. Second, participants in the control condition received only summative feedback (percentage of correct decisions made) following each scenario. To ensure that the time to complete the experiment for the control group was the same as the experimental group, participants in the control group were required to read a journal article describing military leadership.

Scenario presentation and timing. Scheduling constraints precluded the systematic variation of the scenario order, thus, the scenarios were presented in the same order for all of the participants. Further, because of time limit constraints for the experiment, mission time as indicated within the simulation was accelerated for most activities. For example, although, in reality, it may take 90 minutes to secure a UAV and conduct an aerial reconnaissance of the terrain, within the simulation, this activity and feedback to the participant only takes a few minutes. However, the virtual clock shown on the SimFX screen would indicate that 90 minutes had elapsed. This was an effective way to simulate the execution of a full mission within the constraints of the experiment.

It is important to note that the virtual clock also was used to create a sense of urgency and a need to make rapid decisions during the scenarios. In some instances, the scenarios allowed very little actual time, e.g., one minute, to conduct specific mission activities, such as medical evacuation (MEDEVAC). The clock appeared on the SimFX screen and provided the participants with an indication of how much time was remaining for them to make a decision. If the participants waited too long to make a decision, perhaps because they did not obtain critical information from the specific assets available to them, then the simulation would time out. These research design features simulated the time pressures often experienced during naturalistic decision-making situations and emphasized the importance of critical thinking skills for the participants.

Results

Analyses

The research design employed was a mixed factor design. A series of repeated measures ANOVAs with between-subject factors were performed to examine the effects of the training manipulation (between-group factor) on decision scores, SA ratings, workload, and performance over three COE relevant scenarios (trials).

Decision-Making and Number of Assets Used Across Scenarios

Adaptive decisions. Significant treatment, $F(1, 30) = 6.23, p < .05, \eta^2 = .17$ and trial effects, $F(2, 60) = 10.90, p < .01, \eta^2 = .27$, were obtained. The experimental group scored significantly higher across decision points requiring more adaptive responses than the control group. Decision scores for both groups decreased from scenario 1 to 2 and either increased (control) or decreased (experimental) slightly for scenario 3. Decision scores were highest for scenario 1 (Table 2).

Routine decisions. No significant treatment or trial effects were obtained. Routine decision scores remained approximately the same across trials (Table 2).

Number of assets used. The results revealed significant trial, $F(2, 60) = 19.63, p < .01; \eta^2 = .40$, and treatment effects, $F(1, 30) = 5.66, p < .05; \eta^2 = .16$. The mean number of assets used increased over each scenario for both groups. The experimental group used significantly more assets than the control group (Table 2).

Table 2
Mean Decision Scores and Assets Used by Scenario

	Adaptive Decision Scores	Routine Decision Scores	Number of Assets Used
	Mean (SD)	Mean (SD)	Mean (SD)
Scenario 1			
Control	2.85 (.98)	2.86 (.50)	3.19 (1.42)
Treatment	3.77 (.80)	3.00 (.40)	4.50 (1.37)
Combined	3.31 (1.00)	2.93 (.45)	3.84 (1.53)
Scenario 2			
Control	2.45 (.59)	2.93 (.33)	4.13 (2.28)
Treatment	2.92 (.59)	3.02 (.28)	6.00 (2.10)
Combined	2.69 (.63)	2.98 (.31)	5.06 (2.36)
Scenario 3			
Control	2.75 (.74)	2.70 (.39)	6.50 (3.37)
Treatment	2.87 (.59)	2.97 (.38)	7.56 (3.01)
Combined	2.81 (.66)	2.84 (.40)	7.03 (3.19)

Note. $n = 16$ for Control group, $n = 16$ for Experimental group.

Situation Awareness

MARS scores. SA ratings, as assessed by the MARS across the scenarios, showed a pattern similar to the adaptive decision scores. That is, there was a significant trial effect, ($F(2, 66) = 6.98, p < .01; \eta^2 = .18$), where SA scores decreased from scenario 1 to scenario 2 and then increased slightly for scenario 3 (Table 3). SA ratings were highest for scenario 1.

Awareness of evolving situation. Similar to the MARS, the results for this single item assessing how aware participants were of the evolving situation indicated a statistically significant trial effect, $F(2, 66) = 5.68, p < .01; \eta^2 = .15$. Awareness of the situation declined from scenario 1 to scenario 2 and showed no change for scenario 3 (Table 3). However, no treatment effects were found. It is important to note that this single item correlated significantly with the MARS for each scenario (Scenario 1: $r = .61, p < .01$; Scenario 2: $r = .54, p < .01$; Scenario 3: $r = .81, p < .01$).

Table 3
Mean SA Ratings (MARS and Single Item) by Scenario

	MARS Ratings	How aware were you of the evolving situation during the mission?
	Mean (SD)	Mean (SD)
Scenario 1		
Control	2.85 (.50)	3.39 (.98)
Treatment	3.22 (.33)	3.88 (.78)
Combined	3.03 (.46)	3.63 (.91)
Scenario 2		
Control	2.48 (.86)	3.17 (1.04)
Treatment	2.59 (.63)	3.06 (1.09)
Combined	2.53 (.75)	3.11 (1.05)
Scenario 3		
Control	2.80 (.65)	3.17 (.92)
Treatment	2.65 (.52)	3.06 (.66)
Combined	2.72 (.59)	3.11 (.80)

Note. $n = 18$ for Control group, $n = 17$ for Experimental group for Tables 3 and 4.

Workload and Performance Across Scenarios

Workload. The analyses revealed a significant trial effect, $F(2, 66) = 9.9, p < .01; \eta^2 = .23$, for workload. Participants' combined self-ratings of how hard they were working increased from scenario 1 to scenario 2 and decreased slightly for scenario 3 (Table 4). However, no treatment effects were found.

Performance. No treatment effects were found for self-ratings of performance. The trial effect approached significance, $F(2, 66) = 3.09, p = .058; \eta^2 = .09$, with self-ratings of performance decreasing over trials (Table 4).

Table 4

Workload and Performance Ratings Across Scenarios

	How hard were you working during this scenario?	How well did you perform during the scenario?
	Mean (SD)	Mean (SD)
Scenario 1		
Control	2.94 (.94)	3.33 (1.09)
Treatment	3.06 (.90)	3.59 (.94)
Combined	3.00 (.91)	3.46 (1.01)
Scenario 2		
Control	3.39 (.70)	3.11 (1.28)
Treatment	3.82 (.73)	2.94 (.75)
Combined	3.60 (.74)	3.03 (1.04)
Scenario 3		
Control	3.44 (.86)	3.17 (.92)
Treatment	3.65 (.86)	2.76 (.90)
Combined	3.54 (.85)	2.97 (.92)

Effect Sizes

Overall, the effect sizes for the experimental manipulation were relatively modest, ranging from .09 to .40. It is likely that these results are due to the small sample that was used for the present research (Cohen, 1977).

SA – Decision-Making Relationships

To further determine the linkages between SA, assets used, and decision scores, a series of correlations were performed. These findings are described in the following sections.

SA and decision scores. Table 5 shows the correlations between SA, adaptive, and routine decision scores. Higher SA ratings were significantly related to higher adaptive decision scores for scenarios 1 ($r = .65, p < .01$) and 2 ($r = .41, p < .05$) but not for scenario 3. Additionally, higher SA ratings were significantly correlated with higher routine decision scores for scenario 1 ($r = .47, p < .01$) but not for scenarios 2 and 3. All correlations between decision scores and SA were positive.

SA and total number of assets used. The pattern of correlations was similar to the SA and decision-making correlations such that higher SA was related to higher total number of assets used. Correlations were relatively higher for Scenario 1 ($r = .43, p < .01$) compared to those obtained for scenarios 2 and 3 (Table 5).

Number of assets used and decision scores. As shown in Table 5, higher adaptive decision scores were positively correlated ($p < .01$) with usage of assets across all three scenarios. The average correlation between adaptive decision scores and number of assets used, collapsing across scenarios, was $r = .82, p < .01$.

For routine decisions, significant correlations were obtained between assets used and routine decision scores for scenarios 1 ($r = .39, p < .05$) and 3 ($r = .52, p < .01$; Table 5). The average correlation between routine decision scores and number of assets used, collapsing across scenarios, was $r = .44, p < .05$.

Table 5

Correlations Between SA (MARS), Decision Scores, and Assets Used by Scenario

	Correlations		
	Scenario 1	Scenario 2	Scenario 3
SA and Adaptive Decision Scores	.65**	.41*	.13
SA and Routine Decision Scores	.47**	.27	.07
SA and Total Number of Assets Used	.43*	.26	-.01
Total Number of Assets Used and Adaptive Decision Scores	.74**	.85**	.65**
Total Number of Assets Used and Routine Decision Scores	.39*	.11	.52**

Notes. *ns* ranged from .32 - .35.

* $p < .05$; ** $p < .01$.

SA (MARS), Goal Achievement, and Perceived Performance Relationships

Additional correlations were computed between SA (MARS), goal achievement, and perceived performance ratings across mission scenarios. The analyses showed that SA correlated significantly with perceived performance ratings for each mission scenario (r s ranged from .58 to .71, $p < .01$). In addition, participants' ratings of how aware they were of how to best achieve their goals correlated significantly with their ratings of how well they performed across mission scenarios (r s ranged from .50 to .70, $p < .01$). Thus, these results suggest a more consistent relationship between SA and performance (based on subjective ratings) and provide evidence for a conceptual link that increased awareness of how to achieve mission objectives is linked to improved (adaptive) performance (Table 6). Workload ratings were not correlated to either SA or goal achievement.

Table 6

Correlations Between SA (MARS), Goal Achievement, and Perceived Performance by Scenario

	Correlations		
	Scenario 1	Scenario 2	Scenario 3
SA and Perceived Performance	.71**	.58**	.64**
Goal Achievement and Perceived Performance	.70**	.50**	.53**
Workload and SA	.07	-.08	-.10
Workload and Goal Achievement	-.32	.12	-.04

Notes. $n = 35$.

** $p < .01$.

Post Experiment Assessments of Self-Regulation Processes

The results revealed that the experimental group did not differ, statistically, in their self-regulation processes compared to the control group. However, with the exception of one item (*I made sure I had relevant information*), the pattern of responses was consistent with the objectives of the experimental treatment condition to enhance participant self-regulation processes. That is, a higher percentage of the experimental participants versus the control participants thought about whether they had gathered the information they needed and about different ways of looking at the problem as well as made sure they were interpreting information correctly (Table 7).

Table 7

Percent Participants who Agreed/Strongly Agreed with Self-Regulatory Process Items

Item	Condition	% Agree/Strongly Agree
I thought whether or not I had gathered the information I needed.	Control ^a	67
	Treatment ^b	80
I thought about different ways of looking at the problem.	Control ^a	55
	Treatment ^b	67
I made sure I had relevant information.	Control ^a	72
	Treatment ^b	47
I made sure I was interpreting the information correctly.	Control ^a	56
	Treatment ^c	64

Note. ^an= 18, ^bn= 15, ^cn= 14.

Summary

Decision-Making, SA, and Assets

- Participants in the treatment group who received the advance organizer protocol and formative feedback following each decision point during the scenarios obtained significantly higher adaptive decision scores than those in the control group. Adaptive decision scores changed significantly across scenarios, decreasing from scenarios 1 and 2 and increasing slightly for scenario 3. Adaptive decision scores were highest for scenario 1.
- The experimental and control groups did not differ significantly with regard to routine decision scores. Routine decision scores remained the same across scenarios.
- No significant group differences were obtained for either measure of SA. However, for both measures, SA ratings changed significantly over the scenarios. For the MARS, SA decreased from scenarios 1 to 2 and then increased for scenario 3. Adaptive decision scores and MARS ratings generally followed the same pattern over the scenarios. For the single-item measure, SA decreased from scenarios 1 to 2 and then stabilized for scenario 3. SA ratings for both measures were highest for scenario 1.

- The experimental group used significantly more assets than the control group across the scenarios. Asset usage significantly increased over trials for both groups.

Workload and Performance Ratings Across Scenarios

- Assessments of workload changed significantly across the scenarios. Participants' ratings of how hard they were working increased from scenarios 1 to 2 and decreased slightly for scenario 3. The trial effect for performance approached significance with self-ratings of performance decreasing over trials.

Correlations Between SA (MARS), Decision Scores, and Assets Used

- SA was correlated (significantly) with both decision scores for scenario 1 but only adaptive decision-making for scenario 2. There were no significant associations for scenario 3. The correlations for scenarios 1 and 2 were stronger for adaptive than for routine decisions.
- The pattern of correlations between SA and number of assets used across scenarios mirrored that for SA and decision scores. Correlations were strongest for scenario 1 and declined over scenarios 2 and 3.
- Positive correlations were obtained between the number of assets used and adaptive decision scores across all three scenarios. The correlations between number of assets used and routine decision scores mirrored that obtained for the adaptive decision score-total asset correlations for scenarios 1 and 3, but were weaker.

Correlations Between SA (MARS), Goal Achievement, and Perceived Performance

- SA correlated significantly with perceived performance ratings for each mission scenario. In addition, participants' ratings of how aware they were of how to best achieve their goals correlated significantly with their ratings of how well they performed across mission scenarios.

Self-Regulation

- The experimental and control groups did not differ significantly on self-regulation processes/actions. However, with one exception, the pattern of responses from the participants in the experimental condition was consistent with the objectives of the treatment manipulation designed to enhance self-regulation processes.

Discussion

The results from this experiment provided overall support for the two primary research objectives. First, the findings indicated that a low-fidelity desktop computer simulation such as SimFX could be used to train small unit leader SA processes (as described by Endsley, 1997) and adaptive decision-making skills. Further, this training could be conducted in a more cost-effective manner than with other training tools such as the fully immersive virtual simulation described by Pleban et al. (2001).

Second, the findings also indicated that a training strategy, consisting of advance organizers (Power Hungry video, lecture, and PowerPoint presentation to familiarize the trainee in the areas of SA and the application of key leader processes) and formative feedback following each decision point, improved the participants' adaptive decision-making skills. As the experimental group used significantly more assets than the control group, this strategy may have contributed to the higher adaptive decision scores. The number of assets used was positively correlated (significantly) with adaptive decision scores. Overall, the relationship between routine decision scores and assets also was positive but weaker. The differences in the magnitude of the correlations obtained could be that fewer assets were needed to make a correct routine decision.

Assets, SA, and Decision-Making

The focus on increased asset use was assumed to increase SA as defined by Endsley (1997). However the findings did not strongly support this expectation. Although asset use increased over scenarios, SA did not follow the same pattern. In fact, SA was highest after scenario 1 but lower for scenarios 2 and 3. Moreover, increased asset use was significantly correlated with higher levels of SA for scenario 1 but not for scenarios 2 or 3, where no relationship was observed.

Although asset use was highest for scenario 3, it appears that this had a negligible effect on enhancing the participants' SA. This result could be due to qualitative differences between scenarios. Scenario 1 entailed only seven decision points; therefore, it may have been easier for the participants to develop a better overall understanding of the situation than for scenarios 2 and 3 which involved approximately twice the number of decisions. In terms of perceived workload, this also may have been the case. Participant ratings (to the question: *How hard were you working during this scenario?*) showed a significant trial effect, with scenario 1 rated not as hard as scenarios 2 and 3.

It also is possible that the weak relationship between asset usage and SA across the scenarios could be that the information provided by the assets was not informative. This is partially supported by the participants' responses to the SA measures which were significantly higher in scenario 1 than they were in either scenarios 2 and 3.

This research provides additional support for Klein's (1997) research positing a link between SA and effective decision-making in real-world situations. Specifically, higher levels of SA were significantly correlated with higher adaptive decision scores for scenarios 1 and 2 and higher self-ratings of performance across all three mission scenarios. Additionally, greater

awareness of how to achieve mission oriented goals was significantly related to higher performance ratings across all scenarios. The overall findings are also consistent with other research performed in this area by Pleban et al. (2001) who found that SA, consisting of Endsley's (1997) three components (perception and understanding of elements in an environment and the prediction future events) contributed significantly to the prediction of decision-making accuracy. Finally, we note that the lack of findings for SA and adaptive decision-making for scenario 3 may further suggest that scenario 3 was qualitatively different from scenarios 1 and 2.

Possible Mediating Effects of Self-Regulation

One purpose of the formative feedback provided to participants in the experimental condition was to reinforce self-regulation processes to ensure that the participants were scanning the environment thoroughly by using the available assets and monitoring the information for relevance. This, in turn, should lead to higher adaptive decision scores. Our findings lend some support for this idea which showed that the experimental group, receiving the feedback on self-regulation processes, achieved significantly higher adaptive decision scores than the control group.

Further, although the findings reveal no significant group differences for self-regulation processes, a higher percentage of participants in the experimental condition, versus the control condition, thought about whether they had the information they needed, thought about different ways of looking at the problem, and made sure they were interpreting information correctly from the various assets.² In particular, the item showing the largest (and most unexpected) response discrepancy asked if the participants made sure they had all relevant information. Seventy-two percent of the control participants agreed/strongly agreed with this item compared to less than half of the experimental participants (47%). Perhaps the control participants were not as aware of the (possible) informational value offered by the various assets or the various scanning activities they needed to engage in to help address the more adaptive decision points and thus, were confident they had all relevant information. In contrast, the mindset emphasized in the experimental participants may have made them overly vigilant about the possible information available/issues to consider, etc. and less confident that they had all the relevant information needed given the limited time available within each mission scenario. Overall, the adaptive decision and self-regulation findings suggest that the formative feedback provided to the experimental group may have affected the way that the individuals thought about or approached the decisions they were required to make during the scenarios. Future research investigating the mediating effects of self-regulation processes on SA-adaptive decision-making relationships should employ research designs that provide rigorous tests of these relationships. Researchers also could consider using other scales that have been previously developed, e.g., Pintrich, Smith, Garcia, & McKeachie (1993) in this area.

While not a primary research objective, the SimFX desktop simulation system provided us with an opportunity to examine self-regulation as a mediating process in the development of

² We note that although there were no group differences on the self-regulation scores, the pattern of responses support the intent of the experimental treatment and that the lack of significant findings may be due to our inability to find such effects (i.e., low power due to the small sample size).

adaptive decision-making skills, in addition to examining the effects of SA on decision-making. Thus, it may also be used as a test bed for examining decision models and the impact of specific intervention strategies.

Practical Implications

The research indicated that low-fidelity desktop computer simulations can be successfully used to train small unit leader SA and adaptive decision-making skills. These types of simulations can be particularly effective for the inexperienced lieutenant with a basic knowledge of fundamental Infantry operations. From an application standpoint, low-fidelity desktop computer simulations may be most effective during the “walk” phase of training (Pleban et al., 2001). Used in concert with other learning strategies, such as small group discussion sessions, the SimFX desktop simulation system could be used to enhance understanding and also may improve far transfer of skills acquired during training (Burke & Hutchins, 2007).

The configuration of the training environment allowed up to nine participants at a time to be trained with one primary instructor and one assistant. (Participant numbers were limited by the availability of desktop computers.) This makes the SimFX desktop simulation system a more cost effective solution for training SA and decision-making skills when compared with the fully immersive virtual simulation system employed by Pleban et al. (2001). Additionally, SimFX does not require additional technical support personnel to develop the training scenarios or conduct system maintenance activities, unlike most fully immersive virtual simulation systems, which significantly decreases the costs involved in conducting research in these environments.

While promising, one shortcoming was identified that will limit the application of SimFX to large courses such as IBOLC. For the current experiment, data output was voluminous for each participant (37 pages). In its present format, objective performance (decision) data is embedded with other extraneous information. The trainer/instructor would have to go through the output and identify the decision data and manually transcribe it to another database and compute the appropriate analyses. This would result in an unacceptable delay in providing summary feedback to individuals. Feedback from potential users (IBOLC) indicates that an automated procedure is needed to aggregate data across participants so that the instructors can provide timely feedback to the class and monitor trends in performance across classes with limited time expenditure on their part. Further, the SimFX output also contains potentially useful qualitative information, such as the participants’ narratives explaining why they made particular choices, however, these narratives also are embedded with extraneous information which makes it time consuming for the instructor to review and comment on them, particularly for large classes. If training developers can address these data management/analysis issues, then SimFX will be an effective, additional low cost tool for training SA and adaptive decision-making skills within institutional environments.

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Appendix A

Mission Scenario Summary Descriptions and Sample Items, Decision Point Categories, Responsive Options, and Item Point Scores

Scenario I

Secure Key Terrain

SITUATION: Friendly Forces are deployed in the Azeri Republic to the north of Baku. The enemy has established a defensive posture north of your position. You are believed to be opposed by a reinforced infantry company equipped with BTR 60 and BTR 50 personnel carriers. They may also have Russian T55 tanks at their disposal. The enemy's most probable course of action will be to establish a defense in depth in our sector in order to disrupt our forces.

MISSION: 1st Platoon, C Company secures OBJ bayonet NLT 0600 local in order to facilitate the battalion's main attack.

RULES OF ENGAGEMENT: Use of force authorized against all positively identified enemy combatants. Be aware that there are other non-combatant personnel in the area. Minimize harm to local infrastructure.

ATTACHMENTS & ASSETS AVAILABLE:

- Packbot
- UAV
- UGS

TERRAIN: Wooded with heavily and dense foliage. Visibility limited.

EXAMPLE DECISION POINT:

As your platoon is moving forward towards the initial company objective, you hear explosions coming from the Northeast of your location. What do you do?

- (a) Contact Company Commander for guidance
- (b) Change formation to Bounding Overwatch and notify your commander
- (c) Continue mission as planned

In response to option 'C': Why did you choose to continue the mission as planned? In the box below, please briefly describe why you made that decision. (The Soldier is then presented with a text box in which to write a short answer.)

Scenario One

Decision Point Categories, Response Options, and Item Point Scores

Note. An additional point was also given to participants on Adaptive decisions as a reflection that they engaged in an entire adaptive process (i.e., scanned their environment using assets, interpreted the information correctly, and then implemented the correct answer choice). The most adaptive decisions are shaded, **bolded** and *italicized*.

Scenario One	Score
1) PCC (Less Adaptive) - 3 Total Points	
- Redcon1: REDCON1 is sent to you TOC or CO only when requested. You should have conducted pre-combat.	2
- PSG: Pre-combat checks should be completed before a rest plan is initiated.	1
- Correct - You should conduct Pre Combat Checks prior to any mission, then if time permits initiate a rest plan.	3
2) Movement (Less Adaptive) - 3 Total Points	
- Traveling Formation: Traveling formation is only used when time is of the essence and there is no likelihood of enemy contact. You receive a digital transmission from the Company Commander to take up a hasty platoon defensive position while the rest of the company catches up.	1
- Bounding Overwatch: Bounding Overwatch is only used when enemy contact is imminent. You receive a digital transmission from the Company Commander to use a Traveling Overwatch formation so that your platoon does not fall behind.	2
- Traveling Overwatch: Based on the information available to you, this formation gives the best combination of security and speed.	3
3) Reacting (More Adaptive) - 5 Total Points	
- Continue, No UAV: Had you used your UAV, you would have seen enemy activity ahead, indicating that it was a good idea to change formation to Bounding Overwatch and notify your CO. Remember to scan your environment using the available assets in order to determine how the situation has changed.	1
- Guidance, No UAV: You contact your Company Commander and receive a wait out while he maneuvers the two other platoons forward to investigate. Your CO finally comes back up on the net and tells you to go to Bounding Overwatch. You should have used your UAV to determine if there was enemy activity ahead instead of contacting your CO for advice. Remember to scan your environment using the available assets in order to determine how the situation has changed.	2
- Notify, No UAV: Good choice to change formation to Bounding Overwatch and notify your commander. However, you should have used your UAV to confirm that there was enemy activity ahead. Remember to scan your environment using the available assets in order to determine how the situation has changed.	3
- Continue, Used UAV: Given the UAV imagery indicating enemy contact, it would have been wise to switch formation to Bounding Overwatch and notify your CO. Good job using a relevant asset and scanning your environment. Make sure you are interpreting the information given to you by the asset correctly.	2
- Guidance, Used UAV: You know about the likelihood of enemy activity from your UAV recon so seeking guidance from your Company Commander wastes valuable time. Good job using a relevant asset and scanning your environment. Make sure you are interpreting the information given to you by the asset correctly.	3
<i>Notify, Used UAV: Excellent decision. The UAV imagery clearly indicated contact with hostile forces. Good job using a relevant asset, scanning your environment, and implementing an appropriate strategy.</i>	5
4) Minefield (More Adaptive) - 5 Total Points	
- Two, No SITREP, No Packbot: As your two men move forward, they detonate two anti-personnel mines and are critically injured. You should have sent your Packbot ahead of the	1

platoon to provide advance warning of danger. Remember to use the assets available to you before making a decision.	
- Hasty, No SITREP, No Packbot: Your CO chews you out for slowing down the tempo of the operation, and orders you to continue the mission. As you move forward, your first squad detonates an anti-personnel mine injuring two men. You should have sent your Packbot ahead of the platoon to provide advance warning of danger. Remember to use the assets available to you before making a decision.	1
- Engineer, No SITREP, Used Packbot: Good use of your Packbot to keep your men out of harm's way. Your platoon takes up a good Overwatch position providing security for the Engineers, they mark the minefield and find two good bypasses.	5
- Two, No SITREP, Used Packbot: Good use of your Packbot to keep your men out of harms way. As your two men move forward, they stop short of the remains of the Packbot and survey the situation. One of them kneels down and surveys the ground to his front. He taps his wingman, both men return to your concealed position and report that they have found the forward edge of a minefield. Your Engineer squad marks the perimeter of the minefield and finds two good bypasses.	3
- Engineer, No SITREP, No Packbot: Your platoon takes up a good Overwatch position, providing security for the Engineers. You deploy your Engineers and one of them immediately detonates a mine, killing him outright. If you had sent your Packbot ahead of the platoon, you would have detected the minefield's forward edge. The other Engineers successfully mark the perimeter of the minefield and find a bypass. Remember to use the assets available to you before making a decision.	1
- Hasty, No SITREP, Used Packbot: Good use of your Packbot to keep your men out of harm's way. However, your CO chews you out for slowing down the tempo of the operation. Your platoon takes up a good Overwatch position providing security for the Engineers, who mark the minefield and find two good bypasses.	2
- Engineer, Used SITREP, Used Packbot: Good use of your Packbot to find the forward edge of the minefield. Your platoon takes up a good Overwatch position providing security for the Engineers, they mark the minefield and find two good bypasses.	5
- Two, Used SITREP, Used Packbot: Good use of your Packbot to keep your men out of harm's way. As your two men move forward, they stop short of the remains of the Packbot and survey the situation. One of them kneels down and surveys the ground to his front. He taps his wingman, both men return to your concealed position and report that they have found the forward edge of a minefield. Your engineer squad marks the perimeter of the minefield and finds two good bypasses.	3
- Engineer, Used SITREP, No Packbot: Your platoon takes up a good Overwatch position, providing security for the Engineers. You deploy your Engineers and one of them immediately detonates a mine, killing him outright. If you had sent your Packbot ahead of the platoon, you would have detected the minefield's forward edge. The other Engineers successfully mark the perimeter of the minefield and find a bypass. Remember to use the assets available to you before making a decision.	1
5) Actions - (More Adaptive) 6 Total Points	
- Ambush, No UAV: Some dismounts approach your position and you spring the ambush, only realizing after the shooting has stopped that they are the survivors from your attached Scout section. You should have utilized your UAV to survey the situation. Remember to scan your environment for relevant information and utilize your assets before making a decision.	1
- Secure, No UAV, No UGS: You are surprised when an enemy squad suddenly opens fire on your position from the rear, forcing you to take up a hasty defense. You are able to overpower them, but two of your men are wounded and MEDEVACed out. Remember to scan your environment for relevant information and utilize your assets before making a decision.	1
- Ambush, Used UAV: Good job utilizing your UAV, but why did you set up a hasty ambush when you knew the approaching dismounts were friendly? The men turn out to be three scouts who survived the mine field incident. This action results in a reprimand and a formal investigation. Remember to alter your strategy based on the information you gather from your environment.	2

- Secure, No UAV, Used UGS: The information from your ground sensor should have alerted you to the approach of some dismounts. Fortunately, they turn out to be men from your attached Scout section who survived the minefield incident. It would have been to your advantage to send out your UAV as well as your UGS, since your UAV would have told you if the dismounts were friendly or not. Remember to gather information from all relevant assets.	3
Radio, No UAV: The adjacent units confirm that there are no friendly elements in your vicinity. However, by the time you get this feedback, an enemy squad has already opened fire on your position from the rear, forcing you to take up a hasty defense. You are able to overpower them, but two of your men are wounded and MEDEVACed out. You should have utilized your UAV to survey the situation. Remember to scan your environment for relevant information and utilize your assets before making a decision.	2
- Radio, Used UAV: Good job utilizing your UAV and implementing a new strategy. You recognized that the approaching dismounts were friendly, so there was no need for a hasty ambush. The men turn out to be three scouts who survived the mine field incident. They turn over two documents from dead enemy Soldiers, which reveal a possible BP at PV047179.	4
- Secure, Used UAV: Good job utilizing your UAV and implementing a new strategy. You recognized that the approaching dismounts were friendly, so there was no need for a hasty ambush. The men turn out to be three scouts who survived the mine field incident. They turn over two documents from dead enemy Soldiers, which reveal a possible BP at PV047179.	4
- Radio, Used UAV, Used UGS: Good job utilizing your UAV and implementing a new strategy. You recognized that the approaching dismounts were friendly, so there was no need for a hasty ambush. The men turn out to be three scouts who survived the mine field incident. They turn over two documents from dead enemy Soldiers, which reveal a possible BP at PV047179.	6
- Secure, Used UAV: Good job utilizing your UAV and implementing a new strategy. You recognized that the approaching dismounts were friendly, so there was no need for a hasty ambush. The men turn out to be three scouts who survived the mine field incident. They turn over two documents from dead enemy Soldiers, which reveal a possible BP at PV047179.	6
6) Call for Fire (Less Adaptive) - 4 Total Points	
Continue, No Push Msg: You are surprised by a counter attack on your right flank. Two of your men are killed, and two others are badly wounded, requiring MEDEVAC. You should have checked your text messages, which would have alerted you to the enemy forces headed your way.	1
EPW, No Push Msg: Good decision, though perhaps a lucky one. As your platoon establishes their blocking position, they immediately engage and destroy an enemy force coming from the Northeast. You should have checked your text messages. Remember, you have to scan for changes in your environment in order to make successful decisions.	3
Call, No Push Msg: As you call in the fire mission, your right flank collapses under an enemy attack from the Northeast. You should have checked your text messages, which would have warned you of the enemy approach. Remember, you have to scan for changes in your environment in order to make successful decisions.	2
Continue, Push Msg: Choosing to continue is unwise, especially given your knowledge of the enemy movement toward you from the Northeast. Your platoon comes under heavy fire, and two men are killed before you're able to destroy the opposing force. Good job scanning for change, but remember to make your decisions based on the information you gather from your environment.	2
EPW, Push Msg: Excellent decision. As your platoon establishes their blocking they immediately engage and destroy an enemy force coming from the Northeast. Good job scanning for change and making a decision based on the information you gathered from your environment.	4
Call, Push Msg: Your call for fire is a good decision. Friendly artillery begins to impact the enemy position to the Northeast just as you are starting to come under heavy fire. You escape with no injuries to your men.	4
7) Cross (Less Adaptive) - 4 Total Points	

- Cross, No UAV: As your platoon moves across the danger area it is ambushed and wiped out. You should have deployed your UAV to do a quick survey of the area. Remember to scan for change using assets before implementing a strategy.	1
- Send, No UAV: As your far side security starts crossing the danger area it is ambushed and wiped out. You should have deployed your UAV to do a quick survey of the area. Remember to scan for change using assets before implementing a strategy.	2
- Cross, Used UAV: Even with an indication that there are not enemy Soldiers in the area, you should still follow proper procedure for crossing a danger area. Good job using your UAV to gather information about your environment.	3
- Send, UAV: Good, you had an indication that the area was clear, and then followed the proper procedure for crossing a danger area. Good job using your UAV to gather information about your environment.	4

Scenario II

Urban Assault Mission

SITUATION: Friendly forces have pushed the enemy back to the city of Baku. Friendly forces are now preparing to conduct offensive operations throughout the city in order to eliminate any pockets of resistance.

MISSION: 1st Platoon, C Company will serve as a quick reaction force and deploy on order to interdict where needed.

RULES OF ENGAGEMENT: Use of force authorized against all positively identified enemy combatants. Be aware that there are other non-combatant personnel in the area. Minimize harm to local infrastructure.

ATTACHMENTS & ASSETS AVAILABLE:

- SUGV
- ARV
- UAV
- UGS
- Recon Squad

TERRAIN: Baku is a typical urban city with typical urban infrastructure consisting of high rise buildings, industrial complexes, warehouses, and residential areas.

EXAMPLE DECISION POINT:

In one incident as the Brigade advances, threat forces incite a large civilian mob to march on Brigade units. Some forces attack using women and children as human shields. Their goal is to produce fratricide and ideally trap non-combatants in a cross-fire, influencing public opinion through news footage of civilians killed or injured by heavily armed forces. The 1st Platoon of C Company is the lead element that will confront the civilian mob. The Company Commander asks you for your recommendation for disbursing the mob. You consider the following options:

- (a) Use non-lethal munitions
- (b) Use tear gas
- (c) Use mortars to engage the rear of the mob where enemy Soldiers are suspected to be located

Example feedback for option 'C' leading to a short answer question:

This is not a good option since there is a high risk of killing and/or wounding civilians. There is no assurance that the enemy Soldiers are located at the rear of the mob (they may be interspersed).

Why did you choose to use mortars to engage the rear of the mob where enemy Soldiers are suspected to be located? In the box below, please briefly describe why you made that decision. (The Soldier is then presented with a text box in which to write a short answer.)

Scenario Two

Decision Point Categories, Response Options, and Item Point Scores

Note. An additional point was also given to participants on Adaptive decisions as a reflection that they engaged in an entire adaptive process (i.e., scanned their environment using assets, interpreted the information correctly, and then implemented the correct answer choice). The most adaptive decisions are shaded, **bolded** and *italicized*.

Scenario Two	Score
1. Mob: (More Adaptive) - 6 Total Points	
Tear Gas – Used UAV and Weather Report: This is not the best option. The west - NW wind will carry the tear gas back into friendly troops. Also, the distance between the Soldiers and the mob cannot be large in order to deploy the tear gas grenades. Finally, the Soldiers must don their gas masks, which impacts their vision and verbal communications capabilities. Good job utilizing your assets, but make sure to implement an appropriate strategy based on the information you have gathered.	3
Tear Gas – Used UAV, No weather report: This is not the best option. The west wind - NW will carry the tear gas back into friendly troops, which you would have seen if you used you weather report asset. Also, the distance between the Soldiers and the mob cannot be large in order to deploy the tear gas grenades. Finally, the Soldiers must don their gas masks, which impacts their vision and verbal communications capabilities. Good job using your UAV, but remember to use all available assets that will help you implement the appropriate strategy.	2
Tear Gas – No UAV, Used weather report: This is not the best option. The west wind - NW will carry the tear gas back into friendly troops. Also, the distance between the Soldiers and the mob cannot be large in order to deploy the tear gas grenades. Finally, the Soldiers must don their gas masks, which impacts their vision and verbal communications capabilities. Good job using your weather report asset, but you also should have used your UAV to know which direction the mob was moving. Remember to use all available assets that will help you implement the appropriate strategy.	2
Tear Gas – No UAV, No weather report: This is not the best option. The west wind - NW will carry the tear gas back into friendly troops. Also, the distance between the Soldiers and the mob cannot be large in order to deploy the tear gas grenades. Finally, the Soldiers must don their gas masks, which impacts their vision and verbal communications capabilities. Remember to scan your environment using the available assets in order to determine what the best strategy is.	1
<i>Non-lethal Munitions – Used UAV & Weather: This is the best option since it allows a larger stand-off distance between the Soldiers and the mob. It also may force those who are not engaged to assist those who are thereby creating a diversion. Good job using the relevant assets and implementing the appropriate solution.</i>	6
Non-lethal Munitions – Used UAV; No Weather: This is the best option since it allows a larger stand-off distance between the Soldiers and the mob. It also may force those who are not engaged to assist those who are thereby creating a diversion. However You should have checked the weather report to determine wind direction before eliminating tear gas as an alternative. Remember to scan your environment using all the available assets in order to determine what the best strategy is.	4
Non-lethal Munitions – No UAV; Used Weather: This is the best option since it allows a larger stand-off distance between the Soldiers and the mob. It also may force those who are not	4

engaged to assist those who are thereby creating a diversion. However, you also should have used your UAV to know which direction the mob was moving. Remember to scan your environment using the all available assets in order to determine what the best strategy is.	
Non-lethal Munitions – No UAV; No Weather: This is the best option since it allows a larger stand-off distance between the Soldiers and the mob. It also may force those who are not engaged to assist those who are thereby creating a diversion. However, you should have used your UAV to know which direction the mob was moving and the weather report to determine wind direction in order to confirm your decision. Remember to scan your environment using the available assets in order to determine what the best strategy is.	3
Engage: This is not a good option since there is a high risk of killing and/or wounding civilians. There is no assurance that the enemy Soldiers are located at the rear of the mob (they may be intersperse.	1
Engage, Used UAV or Weather Report: This is not a good option since there is a high risk of killing and/or wounding civilians.	2
Engage, Used UAV and Weather Report: This is not a good option since there is a high risk of killing and/or wounding civilians.	3
2) RPG Threat (More Adaptive) - 5 Total Points	
- Call Artillery, Used UAV: This is not the best choice as artillery is better used for area targets and there are friendly aircraft in the vicinity of the target. There is also a greater risk of collateral damage. Good job checking using your UAV to see the RPG threats. Remember to alter your strategy based on the information you gather from your environment.	2
- Call Artillery, No UAV: This is not the best option since artillery is better used for area targets and there are friendly aircraft in the vicinity of the target. There is also a greater risk of collateral damage. You should have checked the UAV message to see the RPG threats location in relation to surrounding buildings, etc. Remember to scan your environment for relevant information and utilize your assets before making a decision.	1
- NLOS, Used UAV: This is not the best option because of the risk of hitting friendly aircraft with incoming mortar rounds. There is also a greater risk of collateral damage. Good job checking using your UAV to see the RPG threats. Remember to alter your strategy based on the information you gather from your environment.	2
- NLOS, No UAV: This is not the best option because of the risk of hitting friendly aircraft with incoming mortar rounds. There is also a greater risk of collateral damage. You should have checked the UAV message to see the RPG threats location in relation to surrounding buildings, etc. Remember to scan your environment for relevant information and utilize your assets before making a decision.	1
- Gunship, Used UAV: This is the best option since the gunship is right there and has access to the video feed from the UAV. Good job checking using your UAV to see the RPG threats and scanning your environment.	5
- Gunship, No UAV: This is the best option since the gunship is right there and has access to the video feed from the UAV. However, you should have checked the UAV message to see the RPG threats location in relation to surrounding buildings, etc. Remember to scan your environment to confirm that your decision is the best solution.	3
3) Monitor Situation (Less Adaptive) - 4 Total Points	
- Infantry: This is not the best option since it will make your platoon less effective in the upcoming urban battle. Also, the single squad may not be a large enough force to contain a reformed mob. Without UAVs, the capability of the squad to monitor the situation is limited.	1
- Ground System: This option is a possibility but the unmanned ground systems are not capable of monitoring large areas and their vision is severely limited by buildings and other obstructions.	2
- Aerial: This is the best option since it provides good visual coverage of the area.	4
- Secure the highest building: While this option is a possibility, it is not the best answer since it requires a lot of manpower and time. An aerial observation is the best way to monitor the situation.	3
4) Clearing Buildings (Less Adaptive) - 3 Total Points	
- LAM: This is not the best option since the LAM has limited ability to “see” the enemy and has	1

problems distinguishing between friendly and enemy troops.	
- FCS: This is the best option since the FCS platforms can provide both LOS and BLOS fires almost immediately when needed.	3
- UAV: This option allows you to see the enemy but does not provide protection since the UAV is not capable of engaging the enemy.	2
5) Fire Support Option (Less Adaptive) - 3 Total Points	
- BLOS: Establish beyond line of sight (BLOS) provides the most responsive fire support and the NLOS mortars are best for engaging buildings because of mortar round's high trajectory.	3
- CAS: Close Air Support (CAS) is a possibility but is less responsive (unless continually on station) and is better suited for other types of missions.	2
- Artillery: Artillery is a possibility but because of normally a flatter trajectory, artillery is not ideal for engaging buildings. There is also a higher risk of collateral damage	1
6) Dismount (More Adaptive) - 6 Total Points	
- 1 Location 1, Used UAV, Used SUGV: Although the UAV report said Location 1 has excellent concealment, it is not the best choice since the SUGV report said it does not have good cover. Good job using your assets, but remember to carefully examine the information given to by your environment before implementing a strategy.	3
- 1 Location 1, Used UAV, No SUGV: Location 1 is not the best choice. Although the UAV report said Location 1 has excellent concealment, you should also have used the SUGV to check for cover. Had you done this, you would have discovered that Location 1 has very poor cover. Remember, use all assets available to you that will help you make the best decision.	2
- 1 Location 1, No UAV, Used SUGV: Location 1 is not the best choice. While you did a good job using the SUGV to check for cover, the report told you cover was very poor. Also, you should have used the UAV to check for concealment. Remember, use all assets available to you that will help you make the best decision and to properly utilize the information you gather from your environment.	2
- 1 Location 1, No UAV, No SUGV: Location 1 is not the best choice. You should have used the UAV to check for concealment (which was excellent) and used the SUGV to check for cover (which was very poor).	1
- 2 Location 2, Used UAV, Used SUGV: Good job. You checked for both cover with the SUGV and concealment with the UAV and chose the best location to dismount. Keep up the good work scanning your environment.	6
- 2 Location 2, Used UAV, No SUGV: Location 2 is the best location to dismount. It had adequate cover and adequate concealment. Good job using the UAV to check for concealment. You also should have used your SUGV to check for cover. Remember, use all assets available to you that will help you make the best decision.	4
- 2 Location 2, No UAV, Used SUGV: Location 2 is the best location to dismount. It had adequate cover and adequate concealment. Good job using the SUGV to check for cover. You also should have used the UAV to check for concealment. Remember, use all assets available to you that will help you make the best decision.	4
- 2 Location 2, No UAV, No SUGV: Location 2 is the best location to dismount. It had adequate cover and adequate concealment. Although you chose the best location to dismount you should have used the SUGV to check for adequate cover and the UAV to check for adequate concealment. Remember, use all assets available to you that will help you make the best decision.	3
- 3 Location 3, Used UAV, Used SUGV: Location 3 is not the best choice. Although the SUGV report said Location 3 has good cover, it is not the best choice since the UAV report said it has very poor concealment. Make sure you interpret the information gathered from your environment correctly before making a decision.	3
- 3 Location 3, Used UAV, No SUGV: Location 3 is not the best choice. You should have used your SUGV to check for cover. Additionally, the UAV report said the concealment at Location 3 was very poor. Make sure you use all the assets available to you that will help you make the best decision and are interpreting the information gathered from your environment correctly.	2
- 3 Location 3, No UAV, Used SUGV: Location 3 is not the best choice. Although the SUGV report said Location 3 has good cover, you should have used the UAV to check concealment	2

as it was very poor. Make sure you use all the assets available to you that will help you make the best decision.	
- 3 Location 3, No UAV, No SUGV: Location 3 is not the best choice. You should have gathered information from your environment by using the UAV to check for concealment (which was very poor) and the SUGV to check for cover (which was good). Make sure you use all the assets available to you that will help you make the best decision.	1
7) Obtain Info (More Adaptive) - 5 Total Points	
- 1 Sensors, Used UAV, Used SUGV: Good job. It is difficult to pinpoint entry points with only aerial vehicles or only ground vehicles in a congested area with multiple buildings. By using both types of sensors you are more likely to get 100% coverage of the building.	5
- 1 Sensors, Used UAV, No SUGV: Although you used the UAV to get aerial photos of the building, you get not get full coverage of the building because of an obstruction. You should have used the SUGV to obtain ground level photos. Remember to scan your environment for all relevant information before making a decision.	3
- 1 Sensors, No UAV, Used SUGV: Although you used the SUGV to get ground level photos of the building, you get not get full coverage of the building because you couldn't see possible roof entry points. You should have used the UAV to obtain aerial photos. Remember to scan your environment for all relevant information before making a decision.	3
- 1 Sensors, No UAV, No SUGV: While using sensors is a good option, you don't get full coverage of the building unless you deploy the UAV and SUGV before you make your decision. Remember to scan your environment for all relevant information before making a decision.	2
- Civilians: Option 2 is not the best option. Civilians may tell you anything and you really need to see videos of the entry points to develop a good plan. Remember to scan your environment for all relevant information before making a decision and to think about a problem from multiple perspectives.	1
Civilians, Used UAV and/or SUGV: Option 2 is not the best option. Civilians may tell you anything and you really need to see videos of the entry points to develop a good plan. Remember to scan your environment for all relevant information before making a decision and to think about a problem from multiple perspectives.	2
8) Determine Threat (More Adaptive) - 4 Total Points	
- Send SUGVs: This is the best option since SUGVs are small and can be deployed stealthily in structures such as air vents. They also will provide visuals that can be used to identify enemy Soldiers and civilians. Good job implementing the best solution.	4
- Send one squad into the building: While this option is good, it would be a better choice to send in the SUGV. They are small and can be deployed stealthily in structures such as air vents. Remember to think about what the assets can do before implementing your decision.	3
- Use UGVs: This is not the best option since the UGVs are not able to see inside or get inside the building. Remember to think about what the assets can do before implementing your decision.	1
- Use Sensors: This is a good option to determine if there are warm blooded beings in the building but cannot distinguish between enemy Soldiers and non-combatants and possibly larger animals such as dogs. Remember to think about what the assets can do before implementing your decision.	2
9) Deception (Less Adaptive) - 4 Total Points	
- Two Teams: Using two clearing teams to confuse the enemy is a possibility but there may be serious coordination problems during the actual clearing operation. Using the UGV is the best option as the UGV is expendable	3
- Remain in your current position and report your position to your Company Commander. FEEDBACK: Remaining in your current position is a possibility, but it does not help solve your current problem. Using the UGV is the best option as the UGV is expendable	2
- UGV: Using the UGV is the best option as the UGV is expendable and will divert the enemy's attention away from the actual breach by the clearing team.	4
- CAS: Close air support is not a good option since you risk injury or death to non-combatants and there is no deception involved. Using the UGV is the best option as the UGV is expendable	1
10) Rescue Hostages (More Adaptive) - 3 Total points	

- 3 Hostage Room 1st: Attacking the hostage room first is not best since it allows time for the enemy Soldiers in the other room to react and engage both the clearing team and the hostages.	1
- 1 Both Rooms: Attacking both rooms at once has the best chance of success since it uses the element of surprise allows minimum reaction time for enemy forces in either room.	3
- 2 Soldier Rooms 1st: Attacking the room containing Soldiers first is not best since it allows time for the militia guards to harm the hostages.	1
11) Mark Buildings (Less Adaptive) - 4 total points	
- 1 UMAS: Using the UMSS is best as it is capable of ensuring that rooms remain secure.	4
- Mark the cleared rooms IAW: While this option is a possibility, using the UMSS is the best option as it is capable of ensuring that rooms remain secure.	3
- 2 X Marker: Using a marker to X doors has no way to ensure rooms remain secure.	1
- 3 Leave a Squad Member: And while leaving a squad member behind is a possibility, depending on how many rooms and buildings there are, the platoon will soon run out of manpower and be unable to conduct other operations.	2
12) Breach Buildings: (Less Adaptive) - 4 Total Points	
- 1 Ground Vehicle, No Recon: This is the best use of assets since the SUGVs are highly adapted to perform both breach and recon functions. It also reduces the risk of injury or death to Soldiers.	4
- 1 Ground Vehicle, Used Recon: This is not the best option. It is good that you used the SUGV for either the breach or recon, but why not use another SUGV rather than risk the lives of the Recon Squad.	3
- 2 Send Recon Team: This option is the not the best as you are not risking the lives of the Recon Squad. A SUGV can perform both breach and recon functions.	1
- 3 UMSS, Used Recon: This option is not the best since the UMSS is not able to breach the building or gain access by itself. A SUGV can perform both breach and recon functions.	2
- 3 UMSS, No Recon: This option is not the best since the UMSS is not able to breach the building or gain access by itself. A SUGV can perform both breach and recon functions.	2
13) Monitor Health (More Adaptive) - 6 Total Points	
- 1 Sensors, Used MULE, No Medic: This is the best option since bio-sensors will indicate who needs evacuating and the MULEs are readily available and accessible to complete the evacuation. Good job using your assets to help you make the best decision.	6
- 1 Sensors, No MULE, Used Medic: You were correct to use bio-sensors to determine who needs evacuating and but you should have considered using the MULEs (rather than a helicopter) to complete the evacuation. The MULEs readily available and accessible to complete the evacuation. It's unlikely that there will be good LZs for the MEDEVAC helicopter in a congested urban area. Good job using your assets to help you make a good decision.	4
- 2 Use SUGVs, Used MULE, No Medic: You should have used bio-sensor signals to check the health of the casualties. SUGVs are not good for monitoring health status. You were correct to use the MULE for evacuation. Make sure you are considering a problem from multiple perspectives before making a decision.	3
- 2 Use SUGVs, No MULE, Used Medic: You should have used bio-sensor signals to check the health of the casualties. SUGVs are not good for monitoring health status. You should have considered using the MULEs (rather than a helicopter) to complete the evacuation. The MULEs readily available and accessible to complete the evacuation. It's unlikely that there will be good LZs for the MEDEVAC helicopter in a congested urban area.	2
- 3 2nd Squad: You should have used bio-sensors to determine who needs evacuating and you should have considered using the MULEs (rather than the 2nd squad) to complete the evacuation. The 2nd squad is busy clearing another building and is not available to assist in the evacuation.	1
- 1 Sensors: No MULE, No Medic: You were correct to use bio-sensors to determine who needs evacuating and but did not select a way to evacuate the wounded (i.e., the MULE or Medic). Make sure you use your assets before making a decision to aid your strategy	2

implementation.	
- 2 Use SUGVs, No MULE, No Medic: You should have used bio-sensor signals to check the health of the casualties. SUGVs are not good for monitoring health status. Also, you did not choose a way to evacuate the wounded. (i.e., the MULE or Medic). Make sure you use your assets before making a decision and think about the problem from multiple perspectives.	1
14) Engage Enemy (Less Adaptive) - 3 Total Points	
- UAV BLOS: This is the best option. Using a UAV to detect the enemy and the FCS BLOS and mortar NLOS fires to engage them is the most effective and responsive means of detection/engagement.	3
- Deploy a squad to investigate the enemy's exact location: While this option is a possibility, it endangers the lives of your squad members and may not be the quickest method.	1
- UAV CAS: This is a possibility but since the enemy is masked by buildings, CAS may have problems engaging them accurately without collateral damage.	2
- SUGV artillery: This option is a possibility but the SUGV is not as effective or as fast in detecting targets as the UAV. Also since the enemy is masked by buildings, artillery may have problems engaging them accurately without collateral damage.	2
15) Transfer Control (More Adaptive) - 4 Total Points	
<i>1 Civ Authorities: This is the best solution if possible. Local civilian authorities understand the situation, know the people, and are familiar with the support structure. They are most qualified to assume routine control (if they are not hostile to friendly forces). International organizations, which have most likely been in the area for some time helping the local population, are the next most qualified to assume routine control.</i>	4
- Request a relief in place from an adjacent unit so you can continue your mission. FEEDBACK: This is not the best solution. A relief may not come for a long time and other units have missions to accomplish as well.	2
2 Combat Services: This is not the best solution, since combat service support units already have a mission to support combat and combat support units. They are also not familiar with the local support structure and local requirements.	1
3 No Transfer: This is not the best solution since an infantry squad is not at all prepared or equipped to assume the duties of routine control of the local civilian population. Also, the platoon will lose combat effectiveness if a squad is left behind.	1
16) Interpret Conversation (Less Adaptive)- 4 Total Points	
- 1 Software: This is the best option since it is the least cumbersome and all required language translations are available in the embedded software.	4
- 2 Use HQ: This option is possible but makes for a very cumbersome and awkward conversation.	1
- 3 Civilian: This option is possible but, although you may find a local civilian who speaks English, that person most likely will not speak other languages for which you require translation.	2
- Utilize your local national interpreter: While this is a good option, best option is the software since it is the least cumbersome and all required language translations are available in the embedded software	3

Scenario III

Assault and Secure Enemy Bridge

SITUATION: Friendly Forces are deployed in the Azeri Republic to the north of Baku. The enemy has established a defensive posture south of your position. You are believed to be opposed by a reinforced infantry company equipped with BTR 60 and BTR 50 personnel carriers. They may also have Russian T55 tanks at their disposal. The enemy's most probable course of action will be to establish a defense in depth in our sector in order to disrupt our forces.

MISSION: 1st Platoon, C Company on order conducts an assault to secure the bridge in vicinity of GA050881 in order to facilitate passage of friendly forces.

RULES OF ENGAGEMENT: Use of force authorized against all positively identified enemy combatants. Be aware that there are other non-combatant personnel in the area. Minimize harm to local infrastructure.

ATTACHMENTS & ASSETS AVAILABLE:

- Class I UAV
- Class II UAV
- UGS1
- UGS2
- ARV
- Medic

TERRAIN: Wooded with heavily and dense foliage. Visibility limited.

EXAMPLE DECISION POINT:

You are now approximately 1 hr (~2 km) from the bridge. Considering again whether some advance recon on the bridge may be warranted, you note the location and orbit of the company's Class II UAV, as depicted on the map. It has a nominal speed of 120 kph. Your organic Class I UAV has a top speed of 60kph.

What is your next action?

- (a) Use organic Class A UAV now
- (b) Use the company's Class II UAV as it orbits it's planned route
- (c) No recon at this time

In response to answer 'A' the following text is presented:

Not the best answer. Again, while your UAV can get imagery quickly, it will be an hour out of date when you reach the bridge.

You review the operations plan and the various sensor information you have received so far in your mind, assessing the soundness of the original plan.

What is your next action?

- (a) I need to replan
- (b) My original plan is still fine
- (c) Huddle with your Platoon Sergeant and Squad Leaders to consider the next course of action

Scenario Three Decision Point Categories, Response Options, and Item Point Scores

Note. An additional point was also given to participants on Adaptive decisions as a reflection that they engaged in an entire adaptive process (i.e., scanned their environment using assets, interpreted the information correctly, and then implemented the correct answer choice). The most adaptive decisions are shaded, **bolded** and *italicized*.

Scenario Three	Score
1) PCC (Less Adaptive) - 3 Total Points	
- Redcon1: REDCON1 status is sent to your TOC or CO only when requested.	2
- PCC: Correct. You should conduct pre-combat checks prior to any mission, then if time permits initiate a rest plan.	3
- PSG: Not the best answer. Pre-combat checks should be completed before a rest plan is initiated.	1
2) Determine Threat (More Adaptive) - 4 Total Points	
<i>- Neither: Good answer. If you arrive at the bridge on schedule, imagery from either UAV will be somewhat stale. Better to conserve those assets until they can yield better information.</i>	4
- My UAV: Though your UAV can give you images in less than 5 minutes, they will be stale by the time you reach the bridge 90 minutes from now.	1
- Company UAV: If you arrive at the bridge on schedule, the most recent imagery from the company UAV would be 14 minutes old.	2
3) Choose Route (More Adaptive) - 6 Total Points	
- A, No UAV for Rte A, B, or C: There was no concealment on this route, exposing you to an ambush.	1
- A, Used UAV for Rte A: This route had no cover, and you exposed yourself to an ambush. When you inform your commander of your decision, he orders you to follow Route B instead.	2
- A, Used UAV for Rte B: Route A offers little concealment and exposes you to ambush. When you inform your commander of your decision, he orders you to follow Route B instead.	2
- B, No UAV for Rte A, B, or C: You encountered a seasonal stream which was flooding and very difficult to cross.	2
- B, Used UAV for Rte C: The map showed Route C to be a poor choice. You encountered a difficult stream on Route B.	3
<i>- B, Used UAV for Rte B: Good choice. Route B seemed promising based on your map analysis, and using your UAV to confirm your choice was worthwhile.</i>	6
- B, Used UAV for Rte B & C: Good choice	4
- B, Used UAV for Rte A: Good choice.	4
- B, Used UAV for Rte A & C: Good choice.	4
- B, Used UAV for Rte A, B, & C: Good choice.	4
<i>- B, Used UAV for Rte A & B: Good. The UAV recon of Route A took time, but supported your decision.</i>	6
- C: Route C is a poor choice. It is the longest route, and there is a significant risk of poor vehicle movement due to thick groves of trees.	1
4) Reconnaissance II: (Less Adaptive) - 3 Total Points	
- My UAV: Not the best answer. Again, while your UAV can get imagery quickly, it will be an hour	2

out of date when you reach the bridge.	
- Company UAV: Good choice. Notice that the company's UAV is off schedule. If you arrive at the bridge in an hour, as you estimate, you will have imagery from the company UAV that is only 10 minutes old.	3
- Neither: Not the best answer. You could have obtained imagery that was only 2 minutes old if you had used the company UAV.	1
5) Minefield (Less Adaptive) - 5 Total Points	
- Original Plan, Used Push Msg, Used SITREP: Excellent. You correctly identified the alert concerning the minefield, and now have a chance to re-route your unit around it. Furthermore, you realized you needed to report this turn of events to higher HQ and did so.	5
- Original Plan, Used Push Msg, No SITREP: Excellent. You correctly identified the alert concerning the minefield, and now have a chance to re-route your unit around it. However, you should have used the SITREP facility to report this turn of events to higher HQ.	5
- Original Plan, No Push Msg, No SITREP: Why did you halt your platoon? Additionally, why did you not check the text message queue, which was blinking to indicate a waiting message concerning a minefield directly in your path? You got lucky this time.	3
- Huddle with your Platoon Sergeant and Squad Leaders to consider the next course of action.	3
- Huddle, Used push message.	4
- New Plan, Used Push Msg: As your unit crosses the minefield, the mines detonate. Two or your Soldiers are wounded in the explosion and MEDEVACed out of the area.	2
- New Plan, No Push Msg: As your unit crosses the minefield, the mines detonate. Two of your Soldiers are wounded and MEDEVACed out of the area.	1
6) Choose New Route (More Adaptive) - 6 Total Points	
- D, No Boundary Overlay: Route D is the longest route by far, and takes you into another company's area of operation. You arrive at the bridge behind schedule.	1
- D, Used Boundary Overlay: Route D is by far the longest route, and as you saw, it takes you into another company's area of operations. You arrive at the bridge behind schedule.	2
- E, No Fire Support: Route E takes you into a swamp with a high risk of mobility problems. Furthermore, this route takes you out of range of your organic fire support. You arrived at the bridge a little behind schedule.	1
- E, Used Fire Support: Route E takes you into a swamp with a high risk of mobility problems. Furthermore, as you saw from your fire support overlay, it takes you out of range of your organic fire support. You arrive at the bridge a little late.	2
- F, No Fire Support, No Boundary Overlay: Route F is a good choice. You arrive at the bridge on schedule.	3
- F, Used Fire Support, Used Boundary Overlay: Good choice. Route F keeps you inside your fire support and out of the AO of another company. You arrive at the bridge on schedule.	6
- F, Used Fire Support Overlay OR Boundary Overlay: Route F is a good choice. You arrive at the bridge on schedule.	4
7) Recon Bridge (More Adaptive) - 7 Total Points	
- Cross, No Recon, No UGS, Used UAV: By using the UAV, you wasted time, lost a valuable asset, and learned nothing about whether or not the bridge was safe to cross.	2
- Cross, No Recon, Used UGS, No UAV: Sensor logs indicated nearly continuous traffic, but without human intelligence, there is no way to know whether this is a hostile force rigging the bridge or civilian traffic.	4
- Cross, Used Recon, no UGS, No UAV: Human intelligence is potentially untrustworthy. You still can not be certain the bridge is safe to cross.	4
- Cross, Used Recon, Used UGS: Good decision. While it is impossible to be certain the bridge is safe, you successfully combined human intelligence and the UGS report to conclude that crossing is a reasonable risk to take.	7
- Cross, No Recon, No UGS, No UAV: You still can not be certain the bridge is safe to cross as you have no information from which to make this decision.	1
- Cross, No Recon, Used UGS, Used UAV: Sensor logs indicated nearly continuous traffic, but there is no way to know whether this is a hostile force rigging the bridge or civilian traffic. Using	3

the UAV wasted precious time and you lost a valuable asset.	
- Cross, Used Recon, No UGS, Used UAV: Human intelligence is potentially untrustworthy. You still can not be certain the bridge is safe to cross. Using the UAV wasted precious time and you lost a valuable asset.	3
- Cross, Used Recon, Used UGS, Used UAV: Overall, good use of your assets. While it is impossible to be certain the bridge is safe, you successfully combined human intelligence and the UGS report to conclude that crossing is a reasonable risk to take. Flying the UAV under the bridge was a waste of valuable time and cost you that asset.	5
- Find, Used Recon, Used UGS: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	3
- Find, Used Recon, No UGS: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	2
- Find, No Recon, Used UGS: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	2
- Find, Used Recon, Used UGS, Made SITREP: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	3
- Find, Used Recon, No UGS, Made SITREP: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	2
- Find, No Recon, Used UGS, Made SITREP: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	2
- Find, No Recon, No UGS, Made SITREP: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	1
- Find, No Recon, No UGS: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	1
- Find, No Recon, No UGS, Made SITREP: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	1
- Find, No Recon, No UGS, Used UAV: You do not have any information indicating that the bridge is unsafe, so it is hasty to decide that you need to find another location to cross. When you inform your CO of your plan, he tells you to cross the bridge anyway.	2
8) Fire Support (Less Adaptive) - 5 Total Points	
- Any Decision, No Assets: It's risky to make this kind of decision without any information.	1
- NLOS, No Fire Support, Used UAV Photo: A good choice, but the original fire support plan is worth considering in this case.	4
- NLOS, Used Fire Support, No UAV Photo: The decision of which fire support to use depends on the target. Unfortunately, you do not know what that is.	3
- NLOS, Used Fire Support, Used UAV Photo: Good choice. The mortars are an appropriate choice given the proximity of the dismounted target to the bridge.	5
- Artillery, No Fire Support, Used UAV Photo: Not is not the best option. The risk of collateral damage to the bridge is too great to use artillery.	2
- Artillery, Used Fire Support, No UAV Photo: The decision of which fire support to use depends on the target. The best choice in this situation was the NLOS.	2
- Artillery, Used Fire Support, Used UAV Photo: Not a good choice. The risk of collateral damage to the bridge is too great to use artillery.	3
- CAS, Used UAV Photo: CAS is the least responsive choice, overkill for a few dismounted enemy, and risky given the proximity of the bridge and the need to preserve it.	2
- CAS, No UAV Photo: CAS is the least responsive choice, and risky given the proximity of the	1

bridge and the need to preserve it.	
9) Casualty Evacuation (More Adaptive) - 4 Total Points	
- MEDEVAC, Used Medic: Why did you request an evac for a minor injury? Your progress is delayed while you wait for the injured man to be picked up.	2
- Ambulance, Used Medic: Why did you request an evac for a minor injury? Your progress is delayed while you wait for the injured man to be picked up.	2
- Continue, Used Medic: Good choice. Your medic confirmed that the injury was not serious.	4
- Ambulance, No Medic: This injury was not serious enough to call for an evacuation. Your progress is delayed while you wait for the injured man to be picked up.	1
- MEDEVAC, No Medic: This injury was not serious enough to call for an evacuation. Your progress is delayed while you wait for the injured man to be picked up.	1
- Continue, No Medic: Unfortunately, the injury was much worse than it initially appeared. You have to place a call to MEDEVAC, and the mission is delayed while you wait.	1
10) Cave Complex (Less) - 3 points total	
- Continue: En route to rendezvous with 3PLT, you receive heavy fire from behind from enemy that were hidden in the cave. You engage and destroy the enemy, wasting valuable time. Had you made a SITREP, your Company Commander could have alerted you to enemy activity around this cave.	1
- Used 2 Soldiers:	2
- ARV:	3
11) Explore: How will you explore the cave? (More Adaptive) - 7 Total Points	
- UGS, Used PushMsg: Good choice. You didn't waste time exploring the cave, and leaving a UGS behind will help ensure the cave remains secure.	7
- Packbot, Used PushMsg: Why did you send the Packbot when you knew the cave was clear? You wasted precious time and the Packbot found nothing.	4
- Packbot, No PushMsg: Had you checked your text messages, you would have seen that the cave complex had already been cleared. You wasted precious time and the Packbot found nothing.	3
- Fire Team, Used PushMsg: Why did you send a 2-man team to investigate when you knew the cave was clear? You wasted time and put lives unnecessarily at risk. The men find nothing.	2
- Fire Team, No PushMsg: The cave complex had already been cleared and consequently the investigation is a waste of time. The 2-man team finds nothing.	1
- UGS, No PushMsg: Had you checked your text messages, you would have discovered that the cave had been cleared. Fortunately, you didn't waste much time dropping the UGS.	5
12) Almost Done (More Adaptive) - 6 Total Points	
- Move, No ARV, No PushMsg: As you move past the enemy position, you are ambushed and your platoon is wiped out.	1
- Move, No ARV, Used PushMsg: A risky decision, since there still may have been enemy forces remaining near your position. However, you made it safely to your destination point.	4
- Move, Used ARV, No PushMsg: A risky decision, since you had no way to confirm that all resistance had been eliminated. However, you made it safely to your destination point.	4
- Move, Used ARV, Used PushMsg: Good decision. The combination of 3PLT's report and the ARV sensor information provided clear indication that no resistance remained.	6
- CAS, No ARV, No PushMsg: You failed to check any sensors, which would have revealed that no resistance remained. Moreover, while you waited for air support, 3PLT was forced to proceed without you and was unable to take OBJ Blue. Your mission is a failure.	1
- CAS, No ARV, Used PushMsg: As 3PLT's report indicated, enemy Soldiers were fleeing the scene, making it unlikely that air support was needed. Moreover, while you waited, 3PLT was forced to proceed without you and was unable to take OBJ Blue. Your mission is a failure.	2
- CAS, Used ARV, No PushMsg: As the ARV sensors indicated, many enemy Soldiers are dead, making it unlikely that air support was needed. Moreover, while you waited, 3PLT was forced to proceed without you and was unable to take OBJ Blue. Your mission is a failure.	2
- CAS, Used ARV, Used PushMsg: As 3PLT's report and the ARV sensors showed, enemy Soldiers are either dead or fleeing, eliminating the need for air support. Your mission is a failure.	3

Appendix B

Available SimFX Assets

Asset Toolbar Buttons



SUGV

Small Unmanned Ground Vehicle and Packbot: Provides reconnaissance of MOUT & subterranean battlespace to gain information domination & assess land domination.



ARV

Armed Robotic Vehicle: Provides remote reconnaissance capability & battle damage assessment. Can report chemical attacks, identify minefields, & provide ballistic protection.



UAV

Unmanned Aerial Vehicle: Class I & II provide RSTA capability at the platoon and company level; has the capability for security/early warning and remote over watch. Use it to find changes in key terrain, avenues of approach, and danger areas in open, rolling, and urban terrain. Class III & IV provides RSTA capability, security/early warning, target acquisition, communications relay, mine detection, & information about the weather.



UGS

Unattended Ground Sensor: Uses multiple ground sensing technologies including acoustic, magnetic, and seismic (ground movement) information. These are stationary assets.



Engineer

Engineer: Displays information collected by engineers about minefields and various other obstacles.

Asset Toolbar Buttons



Recon

Recon: Displays field information collected by a reconnaissance squad.



Medic

Medic: Displays information regarding the medical status of troops.



Msg

Message: Displays general messages including information about current weather conditions.



Map

Map: Displays map overlays. The label on the asset may vary between scenarios but the image will be the same. This button will display the fire support overlay, the maneuver overlay, and the boundary overlay.



SITREP

Situation report: Displays a window where you enter and send situation information to your commanding officer.

Appendix C

Mission Awareness Rating Scale (MARS)

Name/Subject ID _____

Date _____

Scenario (circle one) 1 2 3 4 5

Instructions. Please answer the following questions about the mission you just completed. Your answers to these questions are important in helping us evaluate the effectiveness of this training exercise. Check the response that best applies to your experience.

1. Please rate your ability to *identify* mission-critical cues in this mission.

- _____ very easy – able to identify all cues
- _____ fairly easy – could identify most cues
- _____ somewhat difficult – many hard to identify
- _____ very difficult – had substantial problems identifying most cues

2. How well did you *understand* what was going on during the mission?

- _____ very well – fully understood the situation as it unfolded
- _____ fairly well – understood most aspects
- _____ somewhat poorly – had difficulty understanding much of the situation
- _____ very poorly – the situation did not make sense to me

3. How well could you *predict* what was about to occur next in the mission?

- _____ very well – could predict with accuracy what was about to occur
- _____ fairly well – could make accurate predictions most of the time
- _____ somewhat poor – misunderstood the situation much of the time
- _____ very poor – unable to predict what was about to occur

4. How aware were you of *how to best achieve* your goals during this mission?

- _____ very aware – knew how to achieve goals at all times
- _____ fairly aware – knew most of the time how to achieve mission goals
- _____ somewhat unaware – was not aware of how to achieve some goals
- _____ very unaware – was not aware of how to achieve some goals

Appendix D

Post Trial Participant Subjective Questionnaire

Name/Subject ID_____

Date_____

Scenario (circle one) 1 2 3 4 5

1. Circle the number below that best describes **how hard you were working** during this scenario.

Not hard 1 2 3 4 5 **Extremely hard**

2. Circle the number that best describes **how well you performed** during the scenario

Extremely poor 1 2 3 4 5 **Extremely well**

3. Circle the number that best describes **how aware of the evolving situation** you were during the mission.

Not aware of situation 1 2 3 4 5 **Completely aware of situation**

Appendix E

Post Experiment Questionnaire

Name/Subject ID_____

Date_____

Instructions. Please answer the following questions by checking the appropriate response (if appropriate) and providing a brief explanation of your choice.

1. Do you feel that you still needed some information, not provided by any of the available assets, to make effective decisions during these mission scenarios?

____ Yes ____ No.

If yes, what information would be most helpful?

2. Which assets did you find most useful? Please list and briefly explain.

3. Was the amount of time it took to access and think about the information obtained from the various assets "worth it" in terms of improving the quality of your decisions?

____ Yes ____ No

Why?

<i>For each of the following statements, please indicate the degree to which you agree or disagree.</i>	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
4. When making decisions in the scenario, I thought about whether or not I had gathered all the information I needed to make a good decision.	1	2	3	4	5
5. Before I made a decision, I thought about different ways of looking at the problem.	1	2	3	4	5
6. Making decisions in these scenarios required a lot of mental effort.	1	2	3	4	5
7. I felt I had plenty of time to make good decisions in the simulation.	1	2	3	4	5
8. I made sure I had the relevant environmental information that I needed to make a decision.	1	2	3	4	5
9. When playing SimFX, I sometimes felt overwhelmed with information.	1	2	3	4	5
10. I didn't always have enough time to access information I needed.	1	2	3	4	5
11. When looking at environmental information, I made sure I was interpreting the information correctly before making a decision.	1	2	3	4	5
12. Overall, making decisions in SimFX didn't require a lot of effort.	1	2	3	4	5
13. There was a lot of information to consider before making a decision.	1	2	3	4	5